IDCPA Expert Effects Panel
Panelist: Robert J. Hofman, Ph.D

Question: For each stock, is the estimated number of dolphins affected by the tuna fishery, considering data on sets per year, mortality attributable to the fishery, indicators of stress in blood, skin and other tissues, cow-calf separation, and other relevant indirect effects information, at a magnitude and degree that would risk recovery or appreciably delay recovery to its OSP level (how and to what degree)?

The answer to this question is yes. That is, the available data indicate that

- none of the three depleted dolphin stocks are growing anywhere near the rate that would be expected if the annual mortality levels were substantially less than the estimated maximum net productivity levels; and

- there is good reason to believe that the level of unobserved and unreported mortality has been and is sufficient to appreciably delay, if not prevent, recovery of the three depleted stocks to their OSP levels.

Explanation

The best available data suggest that dolphin stocks that are substantially below their maximum net productivity level (estimated to be about 60% of their carrying capacity or pre-exploitation level) should be capable of growing at about 4% per year if non-natural mortality is near zero. The abundance, mortality and productivity data compiled and analyzed by the staff of the Southwest Fisheries Science Center (SWFSC) indicate that there is a low likelyhood that any of the depleted dolphin stocks are increasing at even two 2% per year. One of the models used to estimate the time it will take for the stocks to recover to 60% of their pre-exploitation abundance levels indicates that it will take 78 years and 65 years, respectively, for the northeastern offshore spotted dolphins and the eastern spinner dolphins to recover to that level, the lower boundary of the OSP range. A second model equally supported by the data indicates that neither stock would recover to 60% of its pre-exploitation level in 200 years, the maximum length of the model projections. The available data are insufficient to estimate the possible growth rate or to project the possible recovery time for the coastal spotted dolphin. It would of course take much longer than the projected times for the stocks to recover to the levels at which they were before the beginning of the tuna purse seine fishery -- i.e., 100% of their pre-exploitation levels or the upper boundary of their OSP ranges.

It is estimated that before the beginning of the tuna purse seine fishery in the eastern tropical Pacific (ETP) there were more than 3,000,000 northeastern spotted dolphins and more than 1,250,000 eastern spinner dolphins. As noted earlier, the available data are insufficient to estimate the pre-fishery abundance of the coastal spotted dolphins. Averaging the abundance estimates resulting from the vessel surveys conducted by the SWFSC in 1998, 1999, and 2000, in response to the International Dolphin Conservation Program Act (IDCPA), provides the following estimates of the current levels of the three stocks: 641,152 northeastern offshore spotted dolphins; 448, 608 eastern spinner dolphins; and 143, 725 coastal spotted dolphins. If the stocks were increasing at the rate of 4% per year, the annual growth increments would be 25,646, 17,944, and 5,749, respectively, and each would have increased in size by about 46% in the last

ten years. If they were increaing at 2% per year, the annual growth increments would be 12,823, 8,972, and 2,875, respectively, and each would have increased in size by about 22% in the last ten years.

Based upon information provided by the Inter American Tropical Tuna Commission (IATTC), the SWFSC estimates that in 1998, 1999 and 2000 there were an average of 5,159 purse seine sets on northeastern offshore spotted dolphins, 2,513 on eastern spinner dolphins, and 154 on coastal spotted dolphins. If an average of only two to four dolphins died during the pre-set chases or after release from the purse seines, the unobserved mortality would be 10,318 to 20,636 for northeastern offshore spotted dolphins; 5,026 to 10,052 for eastern spinner dolphins, and 308 to 616 for coastal spotted dolphins. At the 4 per set level, the unobserved mortality would be approximately 80%, 56%, and 11%, of the respective estimated maximum net growth increments of 25,646, 17,944, and 5,749. In the first two cases this would be sufficient to reduce the annual growth rates to about 0.8% and 1.8% respectfully. If the average unobserved mortality was 5, 6, or more per set, both stocks could be declining.

The key question then is whether there is reason to believe that, on average, two to four or more dolphins die during pre-set chases or after release from purse seines. Several lines of evidence suggest that this is a likely possibility. They are:

1. the historic record of in-set dolphin mortalities indicate that no calves were found with as many as 80% of the lactating females killed in the sets, suggesting that (a) the females abandoned or were separated from their calves prior to encirclement, or (b) their calves were released alive;

2. young calves -- i.e., those that are only a few months old -- will die if they are abandoned by their mothers or their mothers die;

3. the necropsies of the 56 dead dolphins conducted in accordance with the IDCPA's mandated three year necropsy program found that some of the animals had healed heart and muscle damage indicative of past, non lethal trauma and that all of the animals apparently died of heart damage probably related to elevated catecholomises resulting from acute stress;

4. given the preceeding finding, it is likely that at least some proportion of the animals chased, captured, and released alive have heart, muscle, and other lesions that are not lethal and the animals will survive if they are not stressed again before the lesions heal;

5. since the fishery tends to be concentrated in areas where the dophin densities are highest -- i.e., it is not distributed randomly or uniformly over the ranges of the afftected dolphin stocks -- the liklihood of a particular dolphin being chased, and chased and captured, in the hours and days following a chase or capture event is greater than the estimates of the average number of times that the animal would be chased and captured, derived by dividing the estimated numbers of the three species chased and captured annually by the estimated sizes of the stocks. Thus, it is likely that some proportion of the animals stressed by chase or capture on a particular day will be stressed again by chase or captue on succeeding days. In such cases, the apparent stress-related heart and muscle damage could be additive and lead to unobserved mortality during a subsequent chase or following release from a set. As noted earlier, only two to four dolphins would have to die of such additive effects during each of the thousands of pre-encirclement chases or after post-set releases each year to account for the apparent lack of population growth;

6. although there was only one observation of possible pathological elevation of core body temperature and no evidence of stress-related immunosupression found during the Chase and

Encirclement Stress Studies (CHESS), it is important to recognize that this does not mean that these are not sources of unoberved mortality. For example, if only one tenth of one percent of the animals chased had pathologically elevated core body temperatures, an average of nearly 7,000 northern offshore spotted dolphins and nearly 2,500 eastern spinner dolphins would be so affected each year. Similarly, if only one tenth of one percent of the dolphins captured each year had their immune systems affected, making them more vulneralbe to disease, approximately 2,000 northern offshore dolphins and 300 easter spinner dolphins would be affected each year. It also is possible that chronic stress can affect age-specific survival and reproductive rates -- e.g., reduce the life spans of individual animals and the average number of calves produced by females during their lives.

Summary

In summary, there is good reason to believe that the three depeleted dolphin stocks are not recovering at a rate anywhere near what would be expected given the observed and reported mortality levels in the last ten years. Considering all of the possible sources of unobserved mortality, there also is good reason to believe that an average of two to four or more dolphins may die during the thousands of chases and following post-set releases each year. At the lower levels, the average rates of population growth would be between nill and 2%, which seems consistent with the predictive modeling done by the SWFSC. If the average unobserved mortality is greater than about 4 animals for each chase and post-set release, the stocks could be declining.

It is important to keep in mind that an average of two to four or more dolphins may have died during each chase and following post-set release since the beginning of the fishery and that this unobserved mortality would have been comparably trivial when the observed mortalities were in the tens and hundreds of thousands. It also is important to keep in mind that there likely is substantial individual variation in the responses to chase and capture. Additionally, it is important to keep in mind that the depleted stocks would have increased only about 22% in the last ten years if the growth rates were no more than 2% annually and that this level of increase would be nearly impossible to confirm given the lack of reliable stock estimates in the early 1990s and the variability in the survey data. If surveys were carried out five and ten years from now, the likelihood of detecting either slow increases or slow decreases in the stocks in question would be substantially increased. Likewise, the likelihood of determining the significance of possible stress-related heart and muscle damage would be increased subtantially if all of the 300 target sample of animals killed in purse seine sets was necropsied.